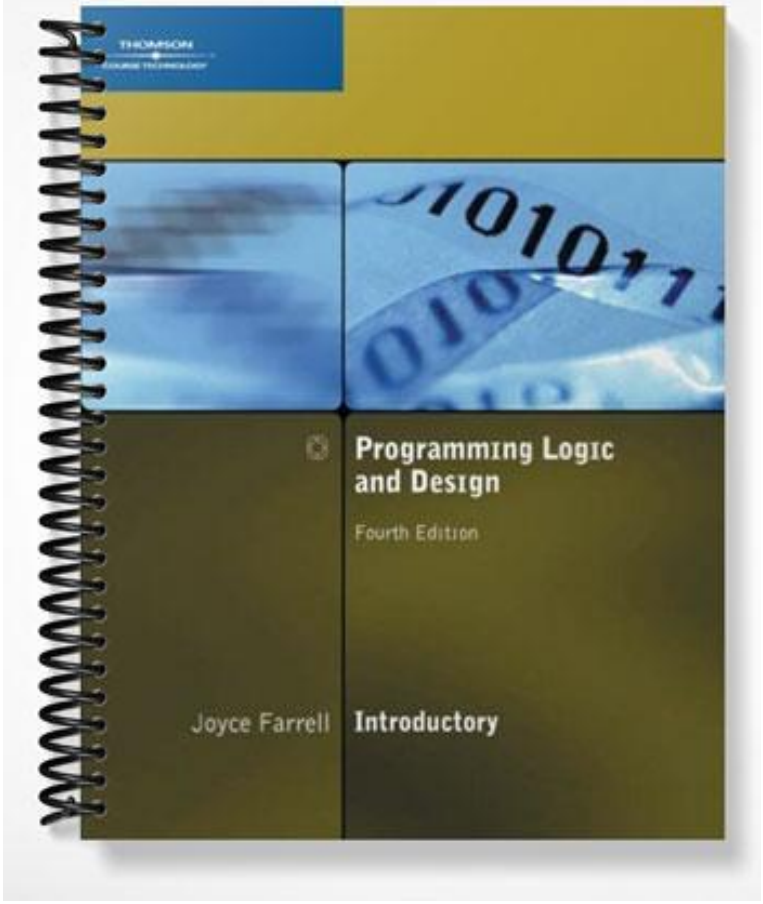
# SOLUTIONS MANUAL



# Chapter 2 Solutions

## Review Questions

1. Snarled program logic is called _____ code.
   a. snake
   b. spaghetti
   c. string
   d. gnarly

*Answer: b*

2. A sequence structure can contain _____.
   a. only one task
   b. exactly three tasks
   c. no more than three tasks
   d. any number of tasks

*Answer: d*

3. Which of the following is not another term for a selection structure?
   a. decision structure
   b. if-then-else structure
   c. loop structure
   d. dual-alternative if structure

*Answer: c*

4. The structure in which you ask a question, and, depending on the answer, take some action and then ask the question again, can be called all of the following except _____.
   a. if-then-else
   b. loop
   c. repetition
   d. iteration

*Answer: a*

5. Placing a structure within another structure is called _____ the structures.
   a. stacking
   b. nesting
   c. building
   d. untangling

*Answer: b*

6. Attaching structures end-to-end is called _____.
   a. stacking
   b. nesting
   c. building

d. untangling

*Answer: a*

7. The statement `if age >= 65 then seniorDiscount = "yes"` is an example of a _____.
   a. single-alternative if
   b. loop
   c. dual-alternative if
   d. sequence

*Answer: a*

8. The statement `while temperature remains below 60, leave the furnace on` is an example of a _____.
   a. single-alternative if
   b. loop
   c. dual-alternative if
   d. sequence

*Answer: b*

9. The statement `if age < 13 then movieTicket = 4.00 else movieTicket = 8.50` is an example of a _____.
   a. single-alternative if
   b. loop
   c. dual-alternative if
   d. sequence

*Answer: c*

10. Which of the following attributes do all three basic structures share?
    a. Their flowcharts all contain exactly three processing symbols.
    b. They all contain a decision.
    c. They all begin with a process.
    d. They all have one entry and one exit point.

*Answer: d*

11. When you read input data in a loop within a program, the input statement that precedes the loop _____.
    a. is called a priming input
    b. cannot result in `eof`
    c. is the only part of a program allowed to be unstructured
    d. executes hundreds or even thousands of times in most business programs

*Answer: a*

12. A group of statements that execute as a unit is a _____.
    a. cohort
    b. family
    c. chunk

d. block

*Answer: d*

13. Which of the following is acceptable in a structured program?
    a. placing a sequence within the true half of a dual-alternative decision
    b. placing a decision within a loop
    c. placing a loop within one of the steps in a sequence
    d. All of these are acceptable.

*Answer: d*

14. Which of the following is not a reason for enforcing structure rules in computer programs?
    a. Structured programs are clearer to understand than unstructured ones.
    b. Other professional programmers will expect programs to be structured.
    c. Structured programs can be broken into modules easily.
    d. Structured programs usually are shorter than unstructured ones.

*Answer: d*

15. Which of the following is not a benefit of modularizing programs?
    a. Modular programs are easier to read and understand than nonmodular ones.
    b. Modular components are reusable in other programs.
    c. If you use modules, you can ignore the rules of structure.
    d. Multiple programmers can work on different modules at the same time.

*Answer: c*

16. Which of the following is true of structured logic?
    a. Any task can be described using some combination of the three structures.
    b. You can use structured logic with newer programming languages, such as Java and C#, but not with older ones.
    c. Structured programs require that you break the code into easy-to-handle modules that each contain no more than five actions.
    d. All of these are true.

*Answer: a*

17. The structure that you can use when you must make a decision with several possible outcomes, depending on the value of a single variable, is the _____.
    a. multiple-alternative if structure
    b. case structure
    c. do while structure
    d. do until structure

*Answer: b*

18. Which type of loop ensures that an action will take place at least one time?
    a. a do until loop
    b. a while loop
    c. a do over loop

d. any structured loop

*Answer: a*

19. A do until loop can always be converted to _____.
    a. a while followed by a sequence
    b. a sequence followed by a while
    c. a case structure
    d. a selection followed by a while

*Answer: b*

20. Which of the following structures is never required by any program?
    a. a while
    b. a do until
    c. a selection
    d. a sequence

*Answer: b*

## Find the Bugs

### Debug 1

```
input midtermGrade
input finalGrade
average = (midtermGrade + finalGrade) / 2
print average
if average >= 60 then
   print "Pass"
else
   print "Fail"
endif
```

### Debug 2

```
input gallonsOfGasUsed
input milesTraveled
while milesTraveled > 0
        milesPerGallon = milesTraveled / gallonsOfGasUsed
        print milesPerGallon
        input gallonsOfGasUsed
        input milesTraveled
endwhile
```

### Debug 3

```
input totalDollarsAvailable
while totalDollarsAvailable not = 0
   dollarsPerDay = totalDollarsAvailable / 7
   print dollarsPerDay
   if dollarsPerDay < 100 then
      print "You better search for a bargain vacation"
```

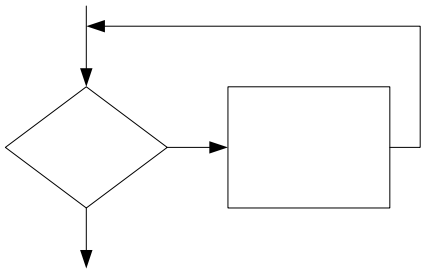
```
      endif
      input totalDollarsAvailable
   endwhile
```

## Exercises

1. Match the term with the structure diagram. (Because the structures go by more than one name, there are more terms than diagrams.)

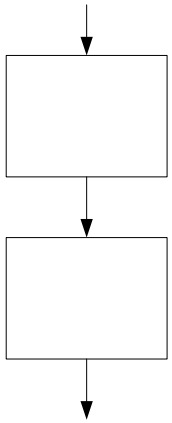
   1. sequence
   2. selection
   3. loop
   4. do-while
   5. decision
   6. if-then-else
   7. iteration

   a.



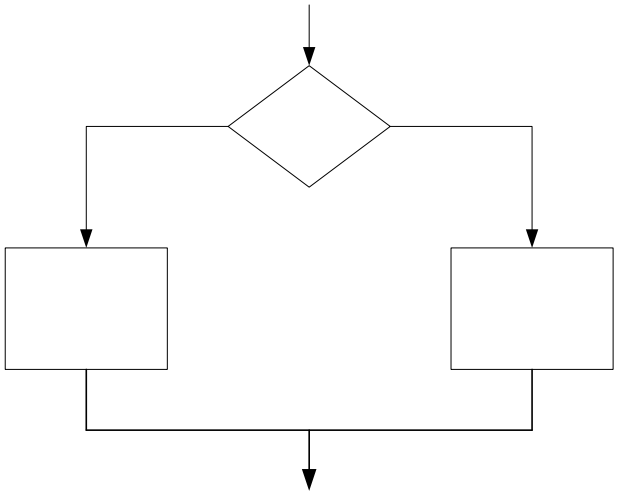
   *Answer*: 3. loop, 4. do-while, 7. iteration

   b.



   *Answer*: 1. sequence

c.



*Answer*: 2. selection, 5. decision, and 6. if-then-else

2. Match the term with the pseudocode segment. (Because the structures go by more than one name, there are more terms than pseudocode segments.)

| | | | |
|---|---|---|---|
| 1. | sequence | 4. | decision |
| 2. | selection | 5. | if-then-else |
| 3. | loop | 6. | iteration |

a.
```
while not eof
    print answer
endwhile
```

*Answer*: 3. loop and 6. iteration

b.
```
if inventoryQuantity  >  0 then
    do fillOrderProcess
else
    do backOrderNotification
endif
```

*Answer*: 2. selection, 4. decision, and 5. if-then-else

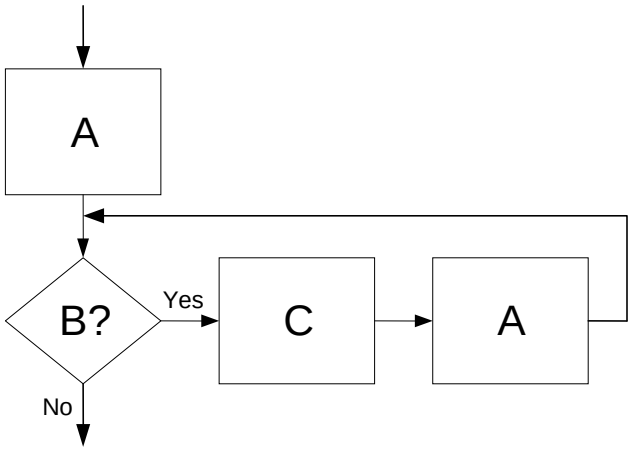
c.
```
do localTaxCalculation
do stateTaxCalculation
do federalTaxCalculation
```

*Answer*: 1. sequence

3. Is each of the following segments structured, or unstructured? If unstructured, redraw it so that it does the same thing but is structured.

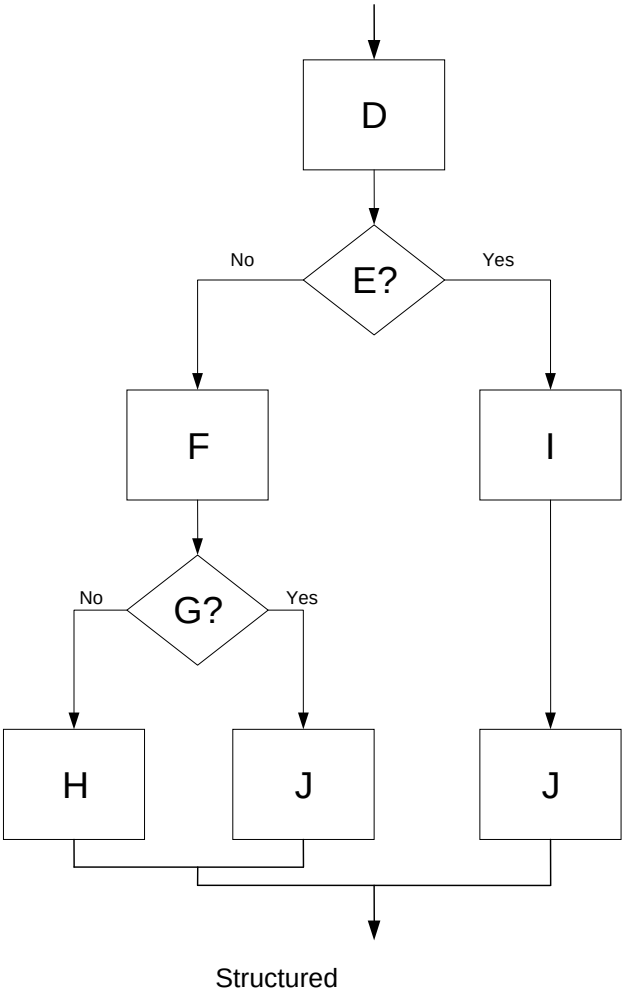
*Answer*:

a. Unstructured



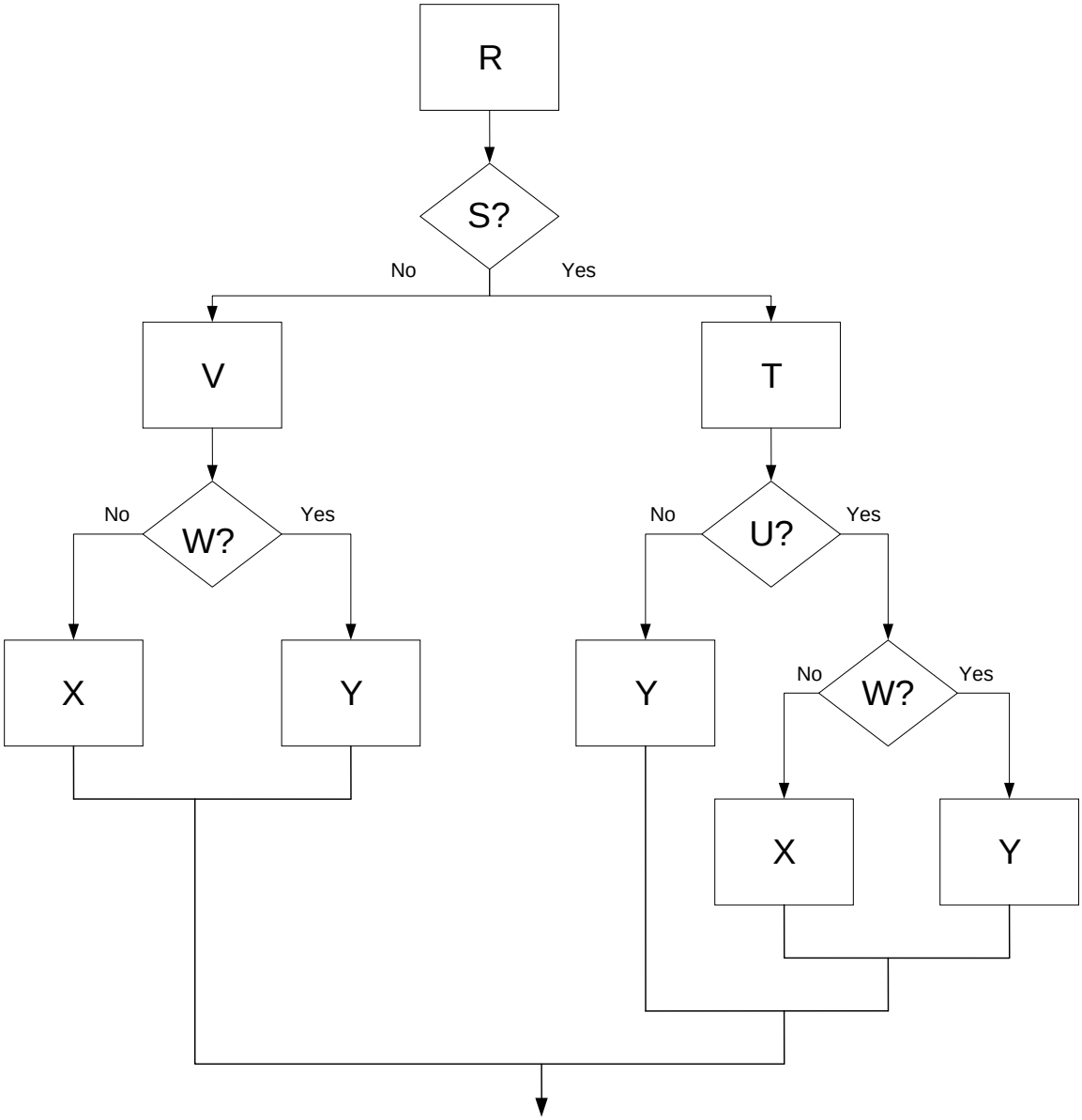

Structured

b. Unstructured




Structured

c. Structured
d. Unstructured




e. Structured

4. Write pseudocode for each example (a through e) in Exercise 3.

*Answer*:

a.
```
do A
while B is true
   do C
   do A
endwhile
```

b.
```
do D
if E is true then
```

```
      do I
      do J
   else
      do F
      if G is true then
        do J
      else
        do H
      endif
   endif
```

c.
```
if K is true then
    if M is true then
       do O
    else
       do N
    endif
    while P is true
       do Q
    endwhile
else
    do L
endif
```

d.
```
do R
if S is true then
   do T
   if U is true then
         if W is true then
               do Y
         else
               do X
         endif
   else
         do Y
   endif
else
   do V
   if W is true then
         do Y
   else
         do X
  endif
endif
```

e.
```
if A is true then
   do B
   while C is true
         do D
   endwhile
   do E
   if F is true then
         do H
   else
```

```
            do G
      endif
   else
      if I is true then
            do J
      else
            do K
            do L
            do M
      endif
   endif
   do N
```

5. Assume you have created a mechanical arm that can hold a pen. The arm can perform the following tasks:
   - ☐ Lower the pen to a piece of paper.
   - ☐ Raise the pen from the paper.
   - ☐ Move the pen one inch along a straight line. (If the pen is lowered, this action draws a one-inch line from left to right; if the pen is raised, this action just repositions the pen one inch to the right.)
   - ☐ Turn 90 degrees to the right.
   - ☐ Draw a circle that is one inch in diameter.

   Draw a structured flowchart or write pseudocode describing the logic that would cause the arm to draw the following:
   a. a one-inch square
   b. a two-inch by one-inch rectangle
   c. a string of three beads

   *Answer*:

   This solution assumes the above tasks are labeled as follows:
   A. Lower the pen to a piece of paper.
   B. Raise the pen from the paper.
   C. Move the pen one inch along a straight line. (If the pen is lowered, this action draws a one-inch line from the left to right; if the pen is raised, this action just repositions the pen on inch to the right.)
   D. Turn 90 degrees to the right.
   E. Draw a circle that is one inch in diameter.

   a. a one-inch square

   **Pseudocode**:

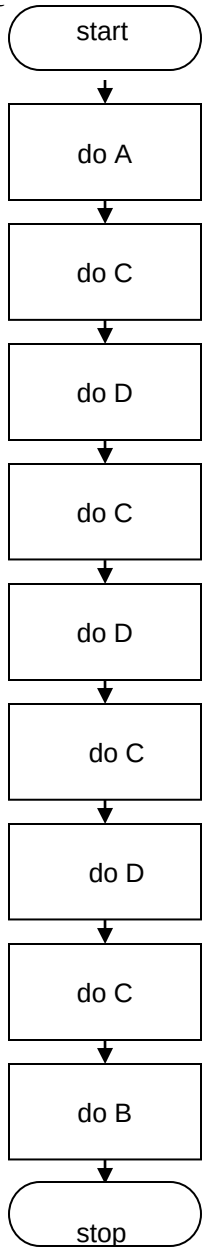
```
start
  lower the pen to a piece of paper
  move one inch along a straight line
  turn 90 degrees to the right
  move one inch along a straight line a line
  turn 90 degrees to the right
  move one inch along a straight line
```

```
  turn 90 degrees to the right
  move one inch along a straight line
  raise the pen from the paper
stop
```

*or*

```
start
  do A
  do C
  do D
  do C
  do D
  do C
  do D
  do C
  do B
stop
```

**Flowchart:**




b. a two-inch by one-inch rectangle

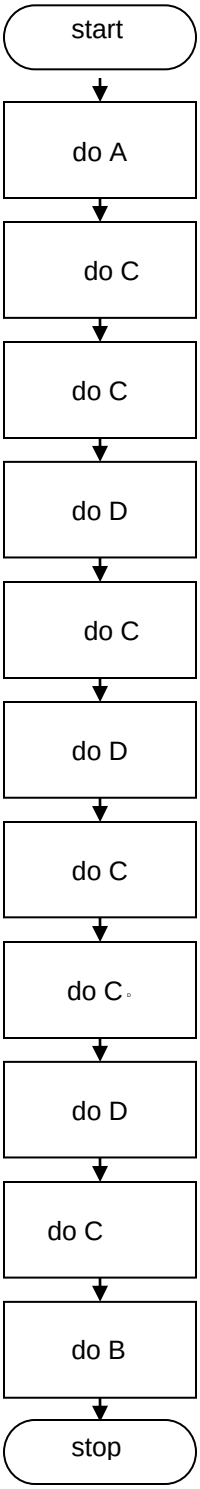
**Pseudocode**:

```
start
  lower the pen to a piece of paper
  move one inch along a straight line
  move one inch along a straight line
  turn 90 degrees to the right
  move one inch along a straight line
  turn 90 degrees to the right
  move one inch along a straight line
  move one inch along a straight line
  turn 90 degrees to the right
  move one inch along a straight line
  raise the pen from the paper
stop
```

*or*

```
start
  do A
  do C
  do C
  do D
  do C
  do D
  do C
  do C
  do D
  do C
  do B
stop
```

**Flowchart:**




c. a string of three beads

**Pseudocode:**

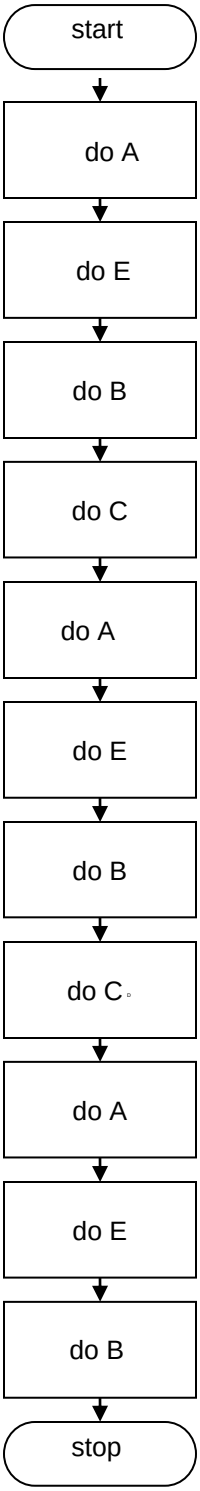
```
start
  lower the pen to a piece of paper
  draw a circle that is one-inch in diameter
  raise the pen from the paper
  move one inch along a straight line
```

```
  lower the pen to a piece of paper
  draw a circle that is one-inch in diameter
  raise the pen from the paper
  move one inch along a straight line
  lower the pen to a piece of paper
  draw a circle that is one-inch in diameter
  raise the pen from the paper
stop
```

*or*

```
start
  do A
  do E
  do B
  do C
  do A
  do E
  do B
  do C
  do A
  do E
  do B
stop
```

**Flowchart:**




Have a fellow student act as the mechanical arm and carry out your instructions.
*Answer*: Students should work in teams to act out each other's instructions.

6. Assume you have created a mechanical robot that can perform the following tasks:
   □ Stand up.

- □ Sit down.
- □ Turn left 90 degrees.
- □ Turn right 90 degrees.
- □ Take a step.

Additionally, the robot can determine the answer to one test condition:

- □ Am I touching something?

Place two chairs 20 feet apart, directly facing each other. Draw a structured flowchart or write pseudocode describing the logic that would allow the robot to start from a sitting position in one chair, cross the room, and end up sitting in the other chair.

*Answer*:

This solution assumes the above tasks are labeled as follows:

A. Stand up.
B. Sit down.
C. Turn left 90 degrees.
D. Turn right 90 degrees.
E. Take a step.
F. Am I touching something?

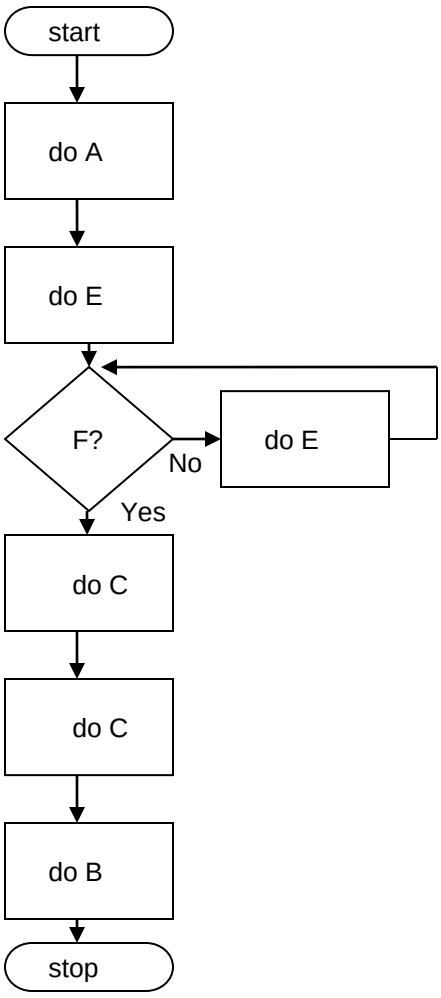
**Pseudocode:**

```
start
  stand up
  take a step
  while Am I touching something is not true
      take a step
  endwhile
  turn left 90 degrees
  turn left 90 degrees
  sit down
stop
```

*or*

```
start
  do A
  do E
  while F is not true
      do E
  endwhile
  do C
  do C
  do B
stop
```

**Flowchart:**



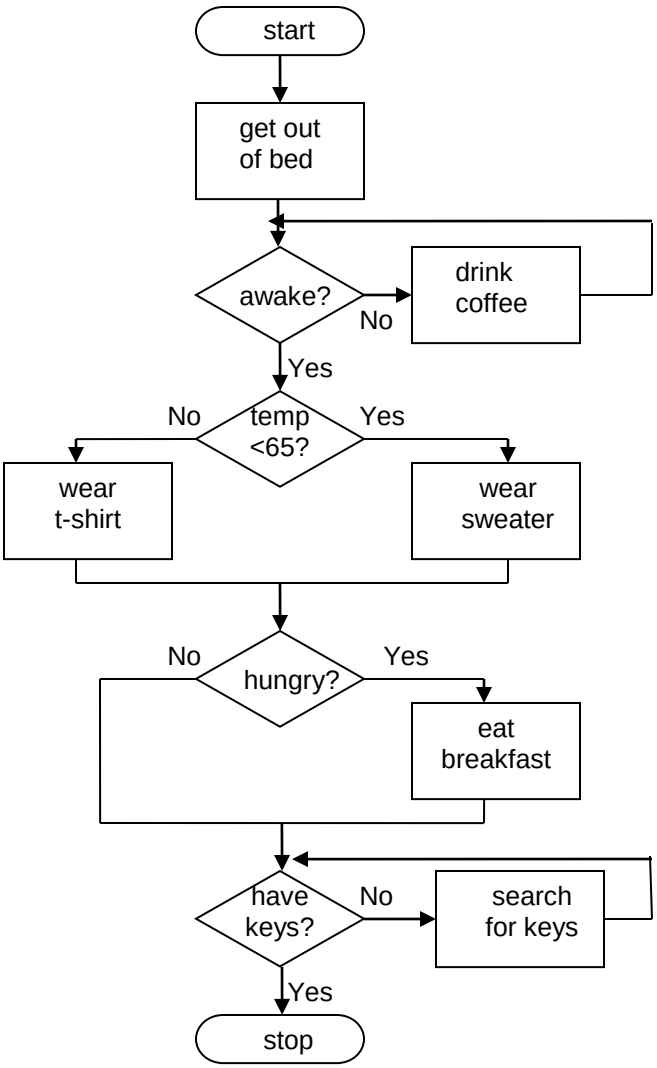

Have a fellow student act as the robot and carry out your instructions.

*Answer*: Students should work in teams to act out each other's instructions.

7. Draw a structured flowchart or write structured pseudocode describing your preparation to go to work or school in the morning. Include at least two decisions and two loops.

*Answer*: Answers will vary. An example solution is shown below.

**Flowchart:**



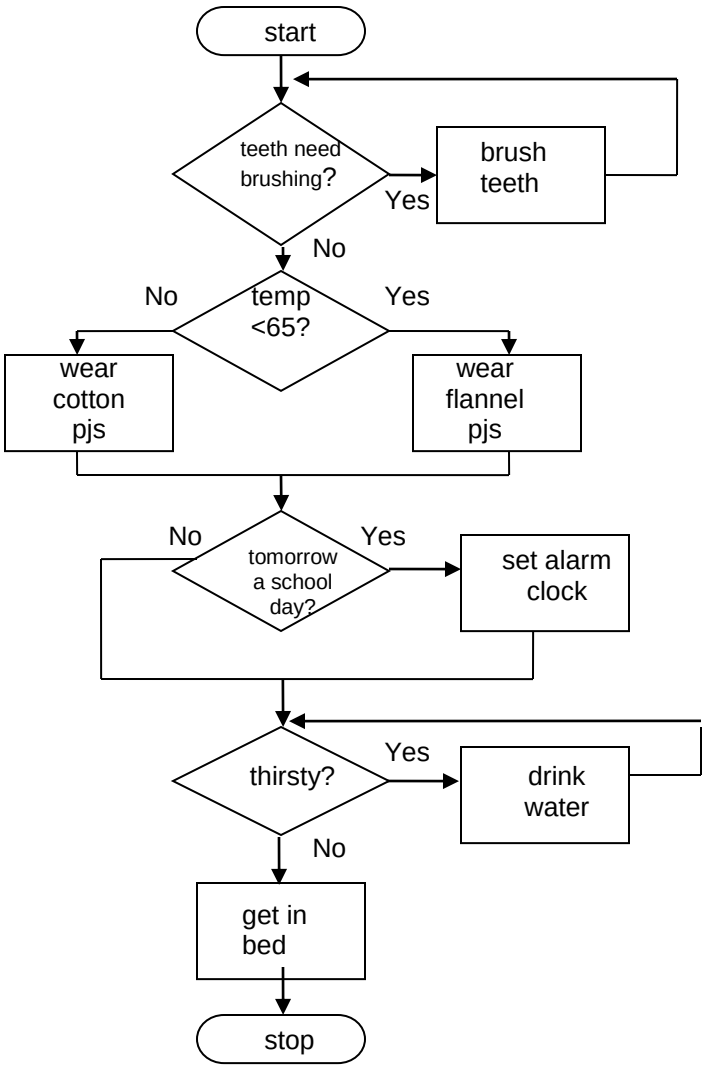

**Pseudocode:**

```
start
    get out of bed
    while awake is not true
        drink coffee
    endwhile
    if temperature < 65 is true then
        wear sweater
    else
        wear t-shirt
    endif
    if hungry is true then
        eat breakfast
    endif
    while have keys is not true
        search for keys
    endwhile
stop
```

8. Draw a structured flowchart or write structured pseudocode describing your preparation to go to bed at night. Include at least two decisions and two loops.

*Answer*: Answers will vary. An example solution is shown below.

**Flowchart:**




**Pseudocode:**

```
start
    while teeth need brushing
        brush teeth
    endwhile
    if temperature is less than 65 degrees then
        wear flannel pajamas
    else
        wear cotton pajamas
    endif
    if tomorrow is a school day then
```

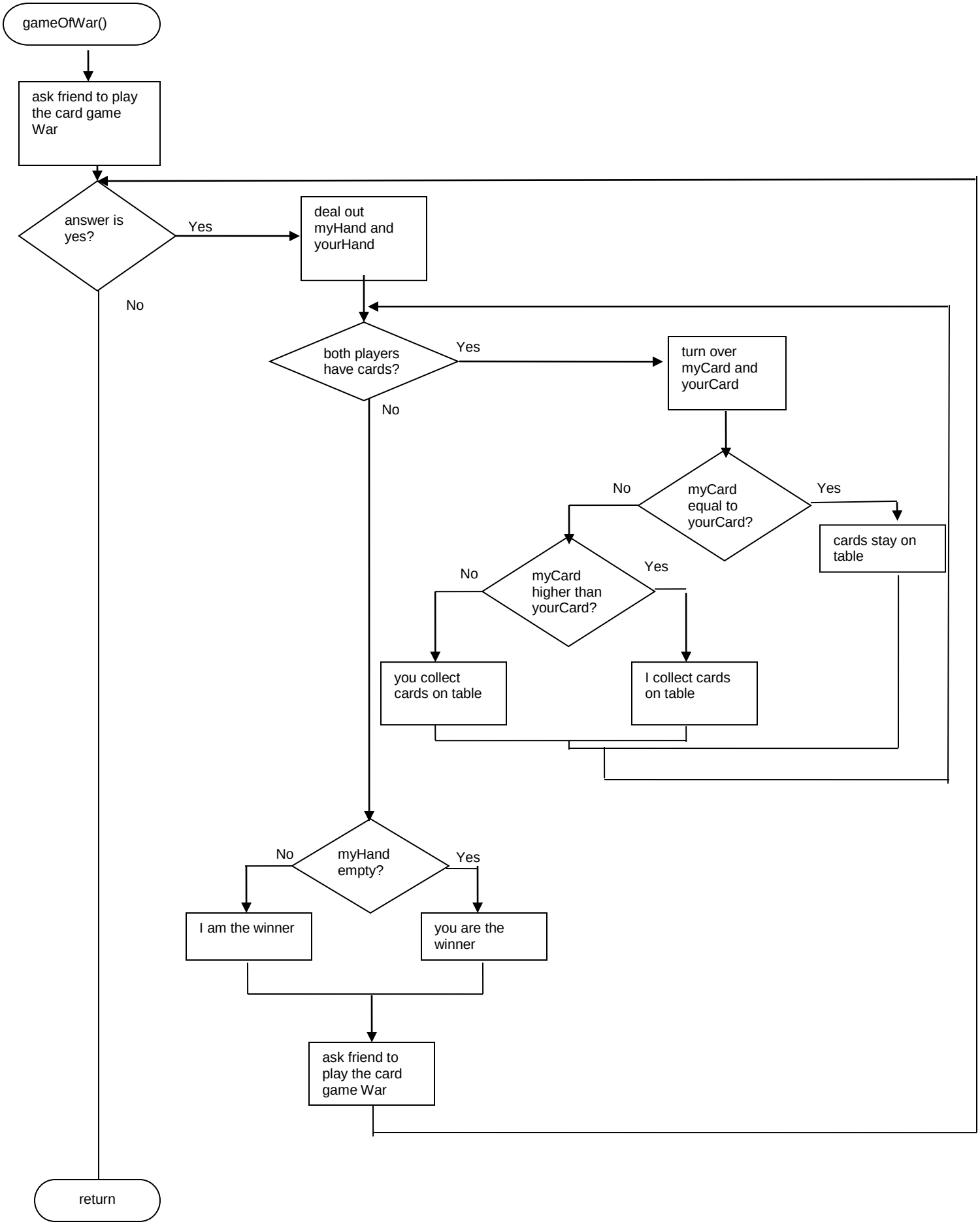
```
            set alarm clock
        endif
        while thirsty
            drink water
        endwhile
        get in bed
    stop
```

9. Choose a very simple children's game and describe its logic, using a structured flowchart or pseudocode. For example, you might try to explain Musical Chairs; Duck, Duck, Goose; the card game War; or the elimination game Eenie, Meenie, Minie, Moe.

*Answer*:

Answers will vary. The following is a possible solution for the card game War.

**Flowchart:**


gameOfWar()
ask friend to play the card game War
answer is yes?
Yes
No
deal out myHand and yourHand
both players have cards?
Yes
No
turn over myCard and yourCard
myCard equal to yourCard?
No
Yes
cards stay on table
myCard higher than yourCard?
No
Yes
you collect cards on table
I collect cards on table
myHand empty?
No
Yes
I am the winner
you are the winner
ask friend to play the card game War
return

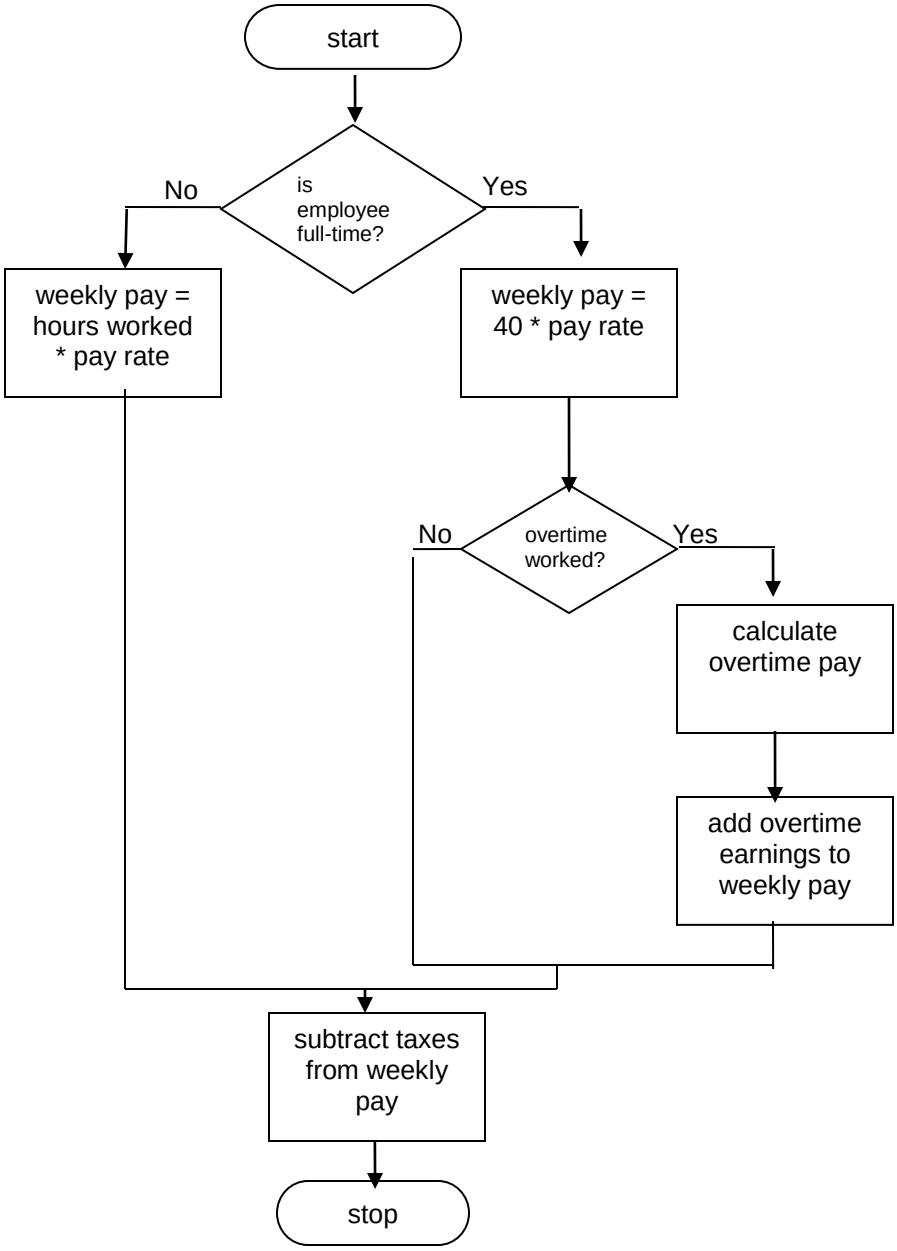
**Pseudocode:**

```
gameOfWar()
     ask friend to play the card game War
     while answer is yes
           deal out myHand and yourHand
           while both players have cards
                 turn over myCard and yourCard
                 if myCard is equal to yourCard then
                       cards stay on table
                 else
                       if myCard is higher than yourCard
                             I collect all cards on table
                       else
                             you collect all cards on table
                       endif
                 endif
           endwhile
           if myHand is empty is true
                 you are the winner
           else
                 I am the winner
           endif
           ask friend to play the card game War
     endwhile
return
```

10. Draw a structured flowchart or write structured pseudocode describing how your paycheck is calculated. Include at least two decisions.

*Answer*: Answers will vary. An example solution is shown below.

**Flowchart:**



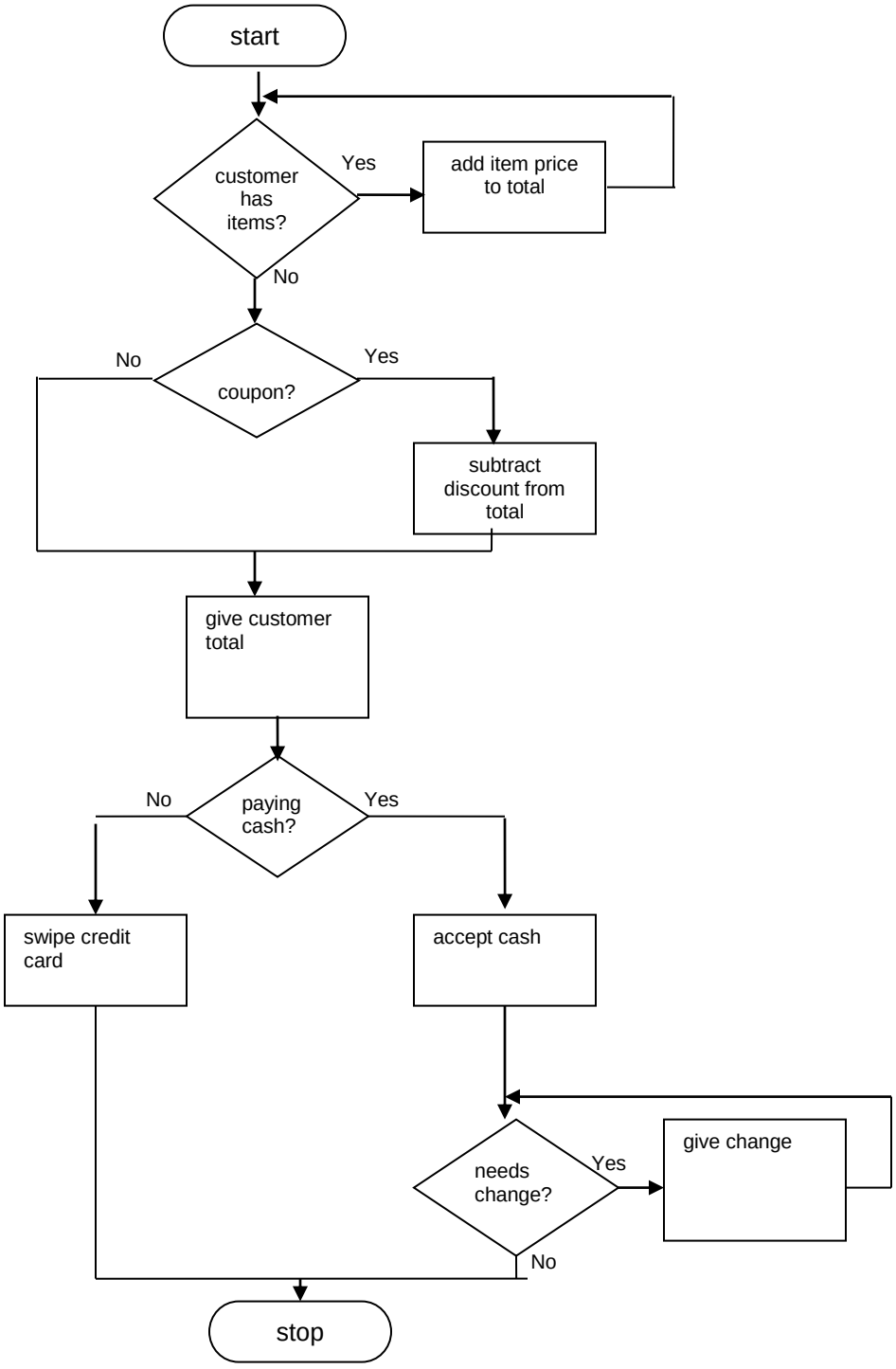

**Pseudocode:**

```
start
    if the employee is full-time is true then
        calculate pay (weekly pay = 40 * pay rate)
        if employee worked overtime is true then
            calculate overtime pay
            add overtime pay to weekly pay
        endif
    else
        calculate pay (weekly pay = hours worked * pay rate)
    endif
    subtract taxes from weekly pay
stop
```

11. Draw a structured flowchart or write structured pseudocode describing the steps a retail store employee should follow to process a customer purchase. Include at least two decisions.

*Answer*: Answers will vary. An example solution is shown below.

**Flowchart:**



**Pseudocode:**

```
start
    while customer has items is true
        add item price to total
    endwhile
    if customer has coupon is true
        subtract discount from total
    endif
    give customer total
    if customer is paying w/cash is true
        accept cash
        while customer needs change is true
            give change
        endwhile
    else
        swipe credit card
    endif
stop
```

## Detective Work

1. In this chapter, you learned what spaghetti code is. What is "ravioli code"?

*Answer*:

Ravioli code is a term for software structure that has components that are small and unconnected (or very minimally connected). Any component can be modified without significantly affecting the other components.

2. Who was Edsger Dijkstra? What programming statement did he want to eliminate?

*Answer*:

Edsger Wybe Dijkstra was a Dutch computer scientist who lived from 1930 to 2002. Among his contributions to computer science are the shortest path-algorithm, also known as Dijkstra's algorithm. He received the Turing Award in 1972. He was also known for his low opinion of the GOTO statement in computer programming, culminating in the 1968 article Go To Statement Considered Harmful . This article was regarded as a major step towards the widespread deprecation of the GOTO statement and its effective replacement by control structures such as the while loop.

3. Who were Bohm and Jacopini? What contribution did they make to programming?

*Answer*:

Bohm and Jacopini were theorists who showed in 1966 that all logical problems could be handled using only the three control structures sequence, selection, and loop.

## Up for Discussion

1. Just because every logical program can be solved using only three structures (sequence, selection, and loop), does not mean there cannot be other useful structures. For example the case, do while, and do until structures are never required, but they exist in many programming languages and can be quite useful. Try to design a new structure of your own and explain under what situations it would be useful.

*Answer*:

Student answers should be creative!
Perhaps a structure with a decision with exactly three outcomes – yes, no, and maybe.
Perhaps a loop that contains another loop called the double-loop and used for situations where two parameters vary and you want to test every possible outcome.