Microprocessors and Microcontrollers

Flow Charts & Assembly Language

EE3954

by

Maarten Uijt de Haag, Tim Bambeck, Harsha Chenji
Flow Chart

Diagram of the sequence of operations in a computer program

This means that you should create your flow diagram such that anyone could implement the program in any programming language. Thus a flow diagram is independent of the programming language.
Flow Chart

Complex Program

Break it down in modules you can easily test
Flowchart Symbology

- **Predefined Process**
  - A named process such as a subroutine or function

- **Process**
  - Any processing step

- **Decision**
  - A decision between two or more paths in the flow diagram

- **Terminator**
  - Indicates the end of program flow

- **On-page Reference**
  - A cross reference from one process to another on the same page

- **Off-page Reference**
  - A cross reference from one process to another on different pages
Examples

SEE HANDOUT:
“Students Guide to Flow Diagrams”
Laboratory Preparation

• Need to see a flowchart of your program:
  - Without a flowchart we (TA and Me) will NOT help you!
  - Exception: Lab #0

• Need to bring a “draft” program

• Bring your Instruction Reference Handout!!
Laboratory Rules
When You are Done

• Remove all “your” software from the PC!
  - Good to bring a storage device such as a USB-drive or Floppy because the lab computer have no internet connection

• Turn off Computer (PC)!

• Turn off Monitor!

• Turn off the microcontroller board!
Laboratory Report

- Two lab partners = one lab report, WORK TOGETHER -flow chart, source code, in-lab, final report write-up.
  - Both names on cover, experiment title & #, date performed
- All reports must be typed!
- All flow-charts must be drawn with a drawing package such as Visio or Powerpoint or equivalent!
- **NO PLAGIARISM!!!**
Laboratory Report

Criteria - 1

- **PROGRAM SOURCE CODE:**
  
  Program is well organized and efficient:
  
  4 pts = excellent.
  
  3 pts = average.
  
  2 pts = needs improvement.
  
  1 pt = poor, but does what it was supposed to do.
  
  0 pt = program does not work at all.
### Use Columns (Tabs)

<table>
<thead>
<tr>
<th>Label Fields</th>
<th>Mnemonic Fields</th>
<th>Argument Fields</th>
<th>Comment Fields</th>
</tr>
</thead>
<tbody>
<tr>
<td>TST</td>
<td>btfss</td>
<td>PORTB,0</td>
<td>; port B bit 0 is tested</td>
</tr>
<tr>
<td></td>
<td>goto</td>
<td>LED_ON</td>
<td>; see flow chart</td>
</tr>
<tr>
<td></td>
<td>goto</td>
<td>LED_OFF</td>
<td>; see flow chart</td>
</tr>
<tr>
<td>LED_OFF</td>
<td>bcf</td>
<td>PORTC,2</td>
<td>; turn LED off</td>
</tr>
<tr>
<td></td>
<td>goto</td>
<td>TST</td>
<td>; return to bit testing statement</td>
</tr>
<tr>
<td>LED_ON</td>
<td>bsf</td>
<td>PORTC,2</td>
<td>; turn on LED</td>
</tr>
<tr>
<td></td>
<td>goto</td>
<td>TST</td>
<td>; return to bit testing statement</td>
</tr>
</tbody>
</table>

**First example of branching (if...then...)!**
Laboratory Report
Criteria - 2

- PROGRAM SOURCE CODE:

  Comments in Source Code:
  
  3 pts = well commented, easy to follow.
  2 pts = average comments, but not easy to follow.
  1 pt = poorly commented, doesn’t explain what is being done.
  0 pt = very little or no comments.
Example

```
TST btfss PORTB,0 ; port B bit 0 is tested
goto LED_ON ; see flow chart

goto LED_OFF ; see flow chart

LED_OFF bcf PORTC,2 ; turn LED off
goto TST ; return to bit testing statement

LED_ON bsf PORTC,2 ; turn on LED
goto TST ; return to bit testing statement
```
Laboratory Report

Criteria - 3

• PROGRAM SOURCE CODE:
  Collection of “Run Time” data:
  3 pts = Data collection complete
  2 pts = Data collection incomplete but minor omission.
  1 pt = Data collection incomplete with major omissions.
  0 pt = No Data collection, or extremely incomplete.
Laboratory Report

Criteria - 4

• WRITEUP:

Flowchart:

3 pts = enough level of detail to implement the complete functionality

2 pts = missing some elements making it hard to write a working program based on this flowchart alone

1 pts = missing major elements making it impossible to write a working program based on this flowchart alone

0 pts = no flowchart present
Laboratory Report
Criteria - 5

• WRITEUP:
  
  **Written description:**
  50% Technical understanding
  50% English grammar, punctuation, spelling
  
  3 pts = good.
  2 pts = needs improvement.
  1 pt = poor, but gives the basic description.
  0 pt = not present.