

CMSC201

Computer Science I for Majors

Lecture 05 – Algorithmic Thinking

Last Class We Covered

- Decision structures
- One-way (using `if`)
- Two-way (using `if` and `else`)
- Multi-way (using `if`, `elif`, and `else`)
- Nested decision structures

Any Questions from Last Time?

Today's Objectives

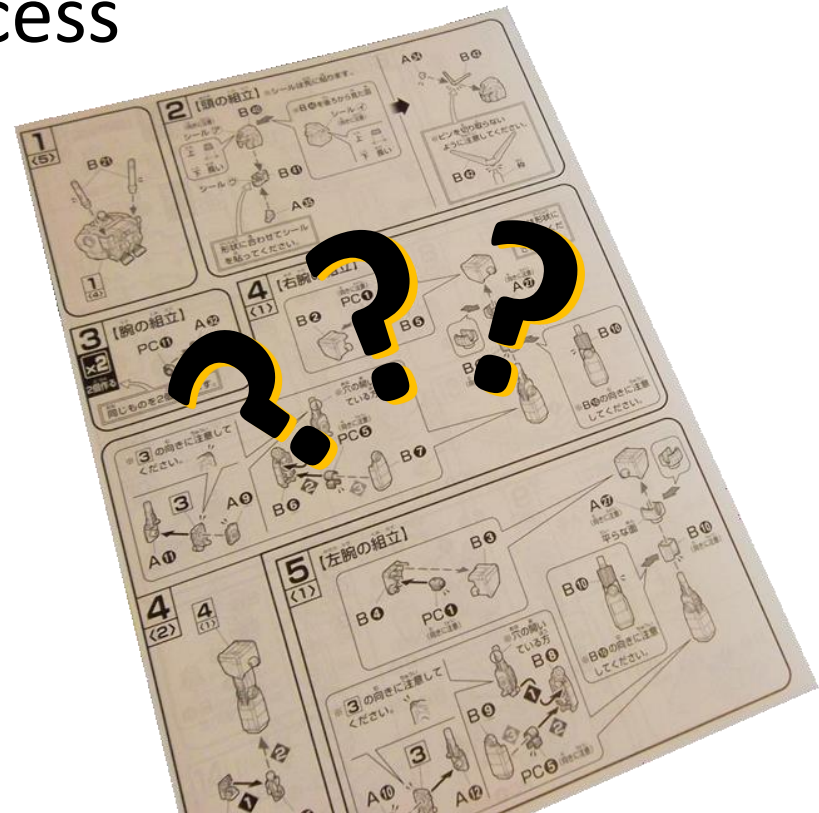
- To practice thinking algorithmically
- To understand and be able to implement proper program development
 - To learn more about “bugs”
- To get practice with decision structures
- (Lots of practice)

What is an Algorithm?

- Steps used to solve a problem
- Problem must be
 - Well defined
 - Fully understood by the programmer
- Steps must be
 - Ordered
 - Unambiguous
 - Complete

Algorithmic Thinking

- Algorithms are an ordered set of clear steps that fully describes a process
- Examples from real life?
 - Recipes
 - Driving directions
 - Instruction manual (IKEA)
 - (maybe not so much)



Developing an Algorithm

Program Development

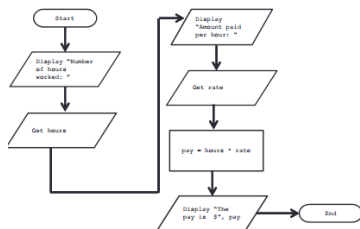
1. Understand the problem
2. Represent your solution (your algorithm)
 - Pseudocode
 - Flowchart
3. Implement the algorithm in a program
4. Test and debug your program

Step 1: Understanding the Problem

- Input
 - What information or data are you given?
- Process
 - What must you do with the information/data?
 - **This is your algorithm!**
- Output
 - What are your deliverables?

Step 2: Represent the Algorithm

- Can be done with flowchart or *pseudocode*



- Flowchart

- Symbols convey different types of actions

- Pseudocode

- A cross between code and plain English

- One may be easier for you – use that one

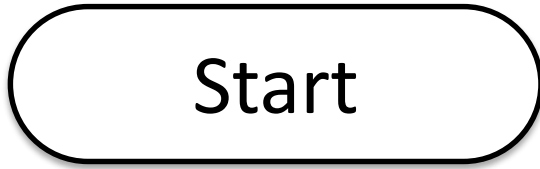
Steps 3 and 4: Implementation and Testing/Debugging

- Implementing and testing/debugging your program are two steps that go hand in hand
- After implementing, you must test it
- After discovering errors, you must find them
 - Once found, you must fix them
 - Once found and fixed, you must test again

Development Example: Weekly Pay

- Create a program to calculate the weekly pay of an hourly employee
 - What is the input, process, and output?
- Input: pay rate and number of hours
- Process: multiply pay rate by number of hours
- Output: weekly pay

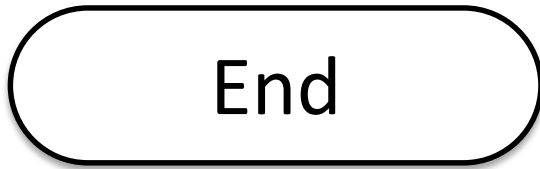
Flowchart Symbols



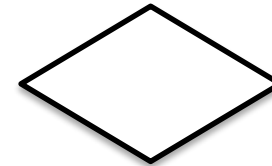
Start Symbol



Input/Output



End Symbol



Decision Symbol

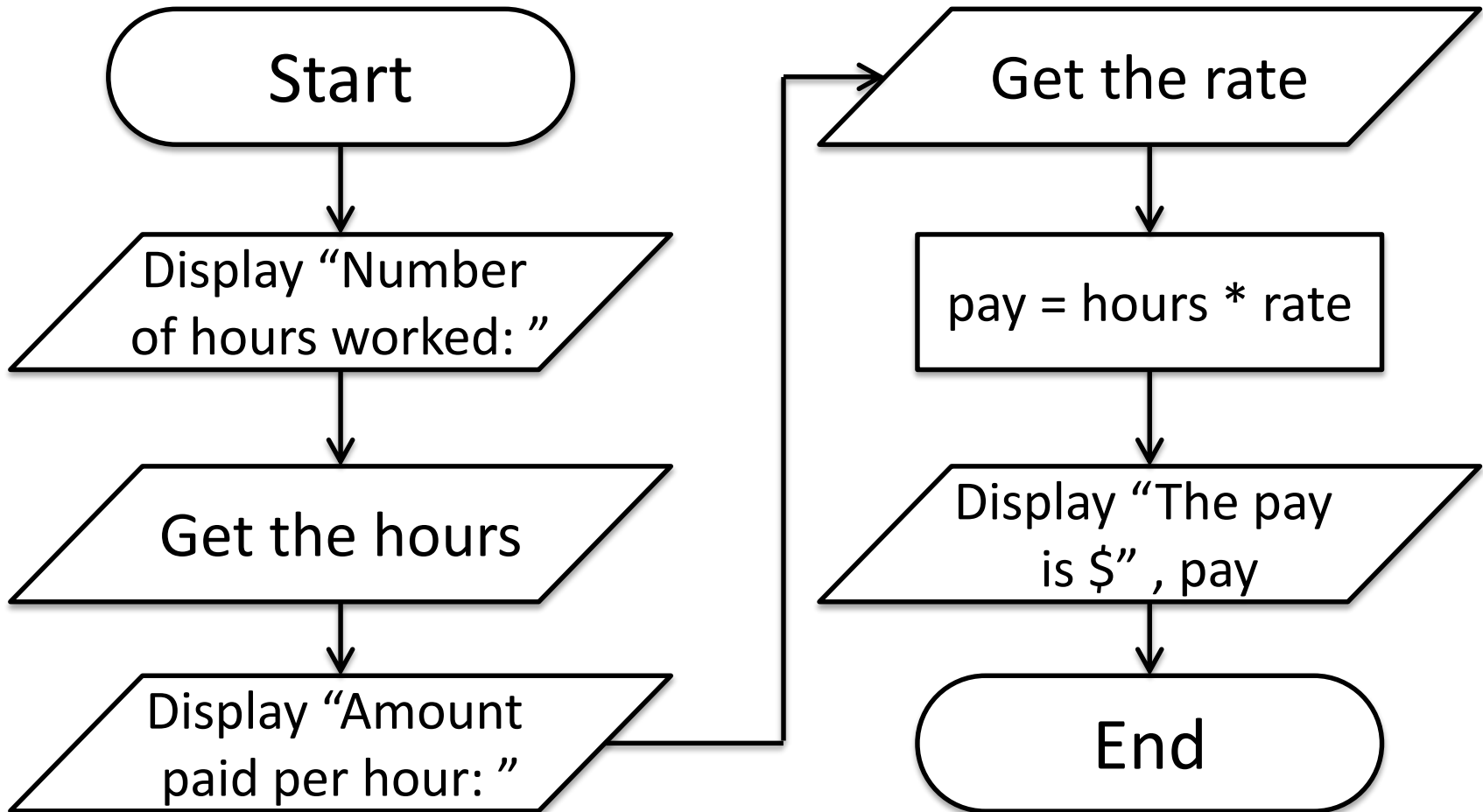


Data Processing Symbol



Flow Control Arrows

Step 2A: Flowchart



Step 2B: Pseudocode

- Start with a plain English description, then...
 1. Display "Number of hours worked: "
 2. Get the hours
 3. Display "Amount paid per hour: "
 4. Get the rate
 5. Compute $\text{pay} = \text{hours} * \text{rate}$
 6. Display "The pay is \$" , pay

Algorithms and Language

- Notice that developing the algorithm didn't involve any Python at all
 - Only pseudocode or a flowchart was needed
 - An algorithm can be coded up in any language
- All languages share certain tools that can be used in your algorithms
 - For example, *control structures* and *expressions*

Exercise: Are Dogs Good?

- Ask the user if a dog is a good dog
- Print out one response for “yes”
- Print out a different response for any other answer



Debugging

A Bit of History on “Bugs”



Rear Admiral Grace Hopper

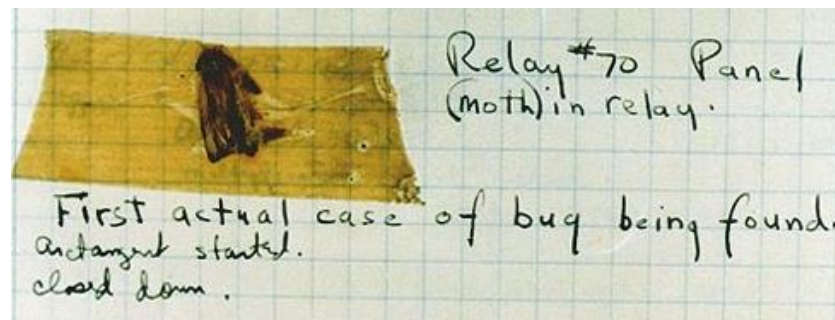
- US Navy lab (Sep 1947)
- Grace Hopper and her colleagues were working on the Harvard Mark II
 - Instructions read one at a time from a tape
- Or trying to... it wasn't working right

A Bit of History on “Bugs”



Mark II, general view of calculator frontpiece, 1948.

- Mark II was a LARGE machine that took up an entire room
 - You could open each panel and look inside
- They found a moth inside the machine
 - Taped the bug into their log book



Errors (“Bugs”)

- Two main classifications of errors
- Syntax errors
 - Prevent Python from understanding what to do
- Logical errors
 - Cause the program to run incorrectly, or to not do what you want



PB&J Using Exact Instructions

- “You’re not even making any sense! He’s already ruined it on purpose, he knows how to make one.”
- Watch the video [here](#)
 - (Image from Josh Darnit’s Exact Instructions Challenge)



Syntax Errors

- “Syntax” is the set of rules followed by a computer programming language
 - Similar to grammar and spelling in English
- Examples of Python’s syntax rules:
 - Keywords must be spelled correctly
 - True** and **False**, not **Ture** or **Flase** or **Truu**
 - Quotes and parentheses must be closed in order:
 - ("open and close")**

Syntax Error Examples

- Find the syntax errors in each line of code below:

```
1   prnit("Hello")
```

```
2   print("What's up?")
```

```
3   print("Aloha!")
```

```
4   print("Good Monring")
```


Syntax Error Examples

- Find the syntax errors in each line of code below:

```
1  prnit("Hello")
2  print("What's up?")
3  print("Aloha!")
4  print("Good Monring")
```

not actually a
syntax error

Syntax Error Examples

- Find the syntax errors in each line of code below:

```
1  prnit("Hello")
2  print("What"s up?")
3  print("Aloha!")
4  print("Good Monring")
```

The syntax highlighting in emacs can often help you see where the errors are

Logical Errors

- Logical errors don't bother Python at all... they only bother you!
- Examples of logical errors:
 - Using the wrong value for something
currentYear = 2013
 - Doing steps in the wrong order
 - “Place pan in the oven. Preheat oven to 350. Pour batter into pan, spreading evenly.”

Comments in Debugging

- Comments are often used to convey what your program is doing
 - If there is a bug, however, your code may not actually be accomplishing that task
- Comments are very useful when debugging, because they separate intent from actuality
 - “Is your code working?” and “Is your code doing what it’s supposed to do?” are very different questions

Practicing Decision Structures

Exercise: Nail Polish

- Dr. Gibson has a LOT of nail polish
- Write a game where the user guesses how many bottles she has, and tell them whether their guess was high, low, or correct
- What info do you need?
 - (She has 297 bottles)



Exercise: Moving on to CMSC 202

- Ask the user their major and the grade they earned in CMSC 201
 - Print out whether they can move on to CMSC 202 next semester
- If they're a CMSC or CMPE major
 - They need an A or a B
- Otherwise
 - They need an A, B, or a C



Daily emacs Shortcut

- **CTRL+S**
 - Allows you to search within a file
 - (To remember: S stands for “search”)
 - Hit CTRL+S, then type in what you want to find
 - Hit CTRL+S again to find the next occurrence
 - If you reach the end of the file and want to start back at the beginning, hit CTRL+S again
 - Use any movement (arrows, etc.) to exit

Announcements

- HW 1 is out on Blackboard now
 - Must complete the Syllabus and Course Website Quiz to see it
 - Due by Friday (February 16th) at 8:59:59 PM
- Pre Lab 4 Quiz will come out Friday @ 10 AM
 - Must be completed by 10 AM Monday morning

Image Sources

- IKEA instructions (adapted from):
 - <https://www.flickr.com/photos/girlinblack/6697086037>
- Three dogs:
 - <https://pixabay.com/p-984015/>
- Rear Admiral Grace Hopper:
 - https://commons.wikimedia.org/wiki/File:Grace_Hopper.jpg
- Mark II:
 - <http://amhistory.si.edu/archives/images/d8324-1.jpg>
- Notebook bug (adapted from):
 - <https://commons.wikimedia.org/wiki/File:H96566k.jpg>
- Computer bug:
 - <https://pixabay.com/p-1296767/>
- Nail polish (adapted from):
 - <https://pixabay.com/p-870857/>
- Question mark man:
 - <https://pixabay.com/p-1019993/>