Structured Programming
- Problem Solving and Program Design

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With Thanks to Dr. Xin Feng and Dr. Haipeng Guo

Outline

- Problem solving
- Program design
- Flowcharts

Structured Programming

Problem Solving

Question:

How do you solve daily problems?

Steps:
- State the problem (e.g., hard to follow a course)
- Analyze the problem (class attendance, TA help, slides review, …)
- Decide the activities to take (attend the class, go to tutorial, consult TA, print slides, review slides)
- Perform the activities
- Evaluate the effect of the activities (Is it easier now to follow the course)

Program Design

Question:

How do we write a program?

Steps:
- State the problem (E.g., Convert US dollars into RMB Yuans)
- Analyze the problem (we need to know the amount of US dollars and then after conversion we know the amount of RMB)
- Decide the activities to take (input US dollar amount, output the RMB amount)
- Perform the activities (write a C program and execute the program)
- Evaluate the effect of the activities (Check if the result is expected)

Program Design

- Those activities are actually steps to solve the problem.
  - The steps are called an algorithm
- Figuring out an algorithm is the key in C programming
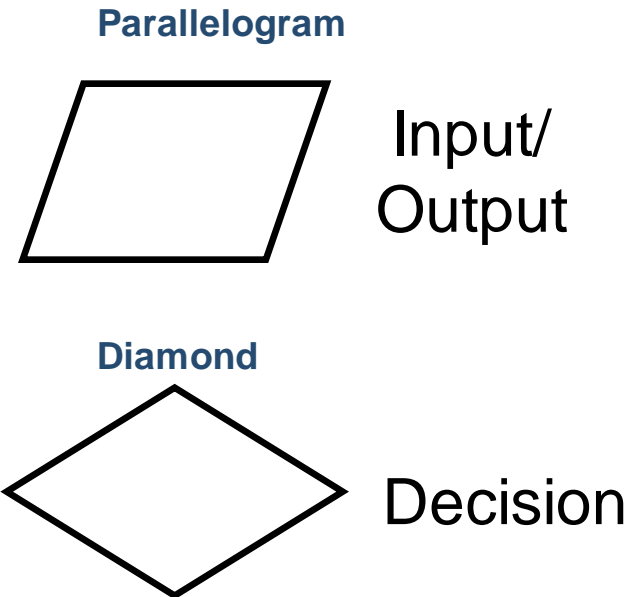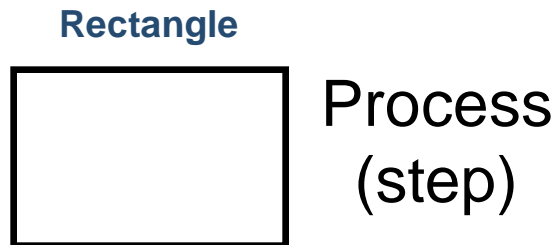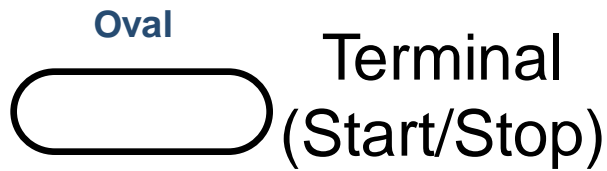- We can use a flowchart to describe an algorithm

| Input US dollar amount |

(A variable to place the value of the US dollar amount, use scanf to read)

| Calculate the RMB amount |

(A variable to place the value of the RMB dollar amount)

| Output the result |

(Use printf to display)

Program Design

Oval

⬭ Terminal (Start/Stop)

Parallelogram

▱ Input/ Output

Rectangle

▭ Process (step)

Diamond

◇ Decision

Flow line

→ Logical flow

A Flowchart

The complete flow chart of the former example

```
        ┌─────────┐
        │  Start  │
        └─────────┘
             │
             ▼
      ╱──────────────╲
     ╱  Input US dollar ╲
     ╲     amount      ╱
      ╲──────────────╱
             │
             ▼
   ┌─────────────────────────┐
   │ Calculate the RMB amount │
   └─────────────────────────┘
             │
             ▼
      ╱──────────────╲
     ╱   Output RMB    ╲
     ╲     amount      ╱
      ╲──────────────╱
             │
             ▼
        ┌─────────┐
        │   End   │
        └─────────┘
```

Structured Programming
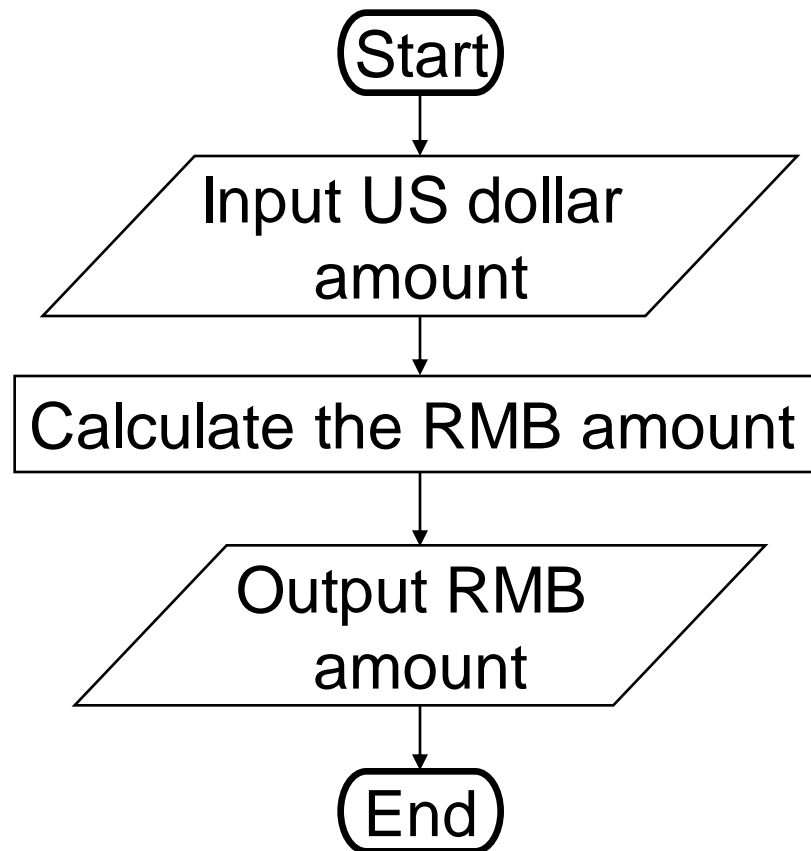
Further Refinement of the Flowchart

A flowchart can be further refined.
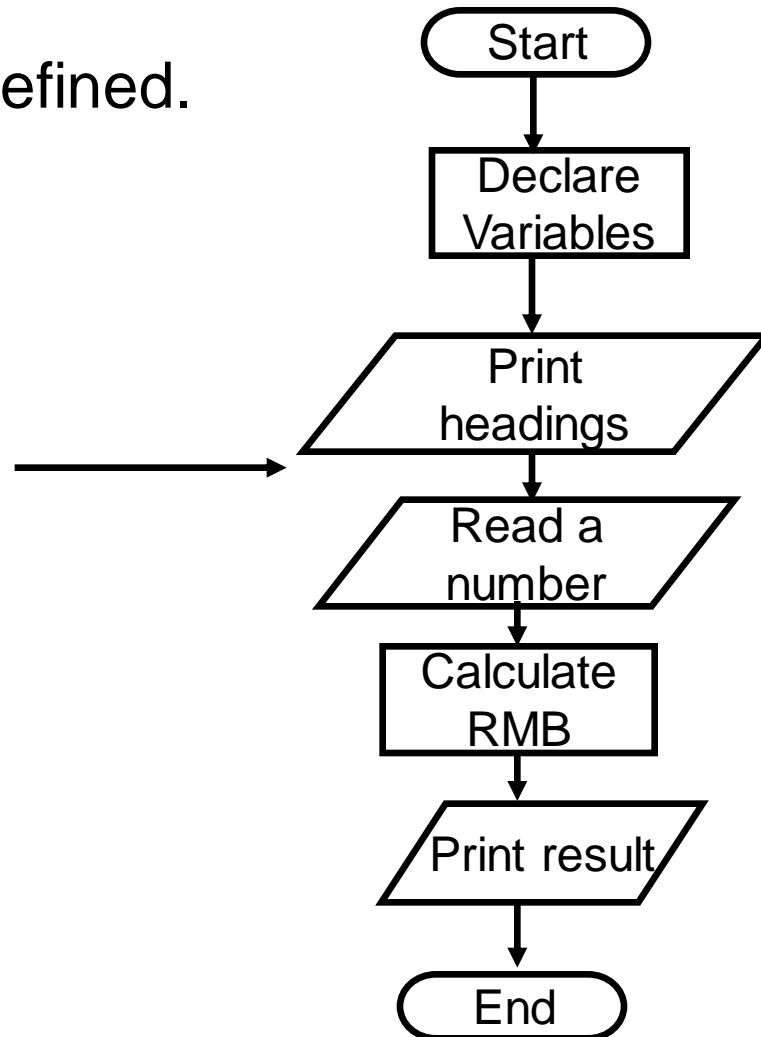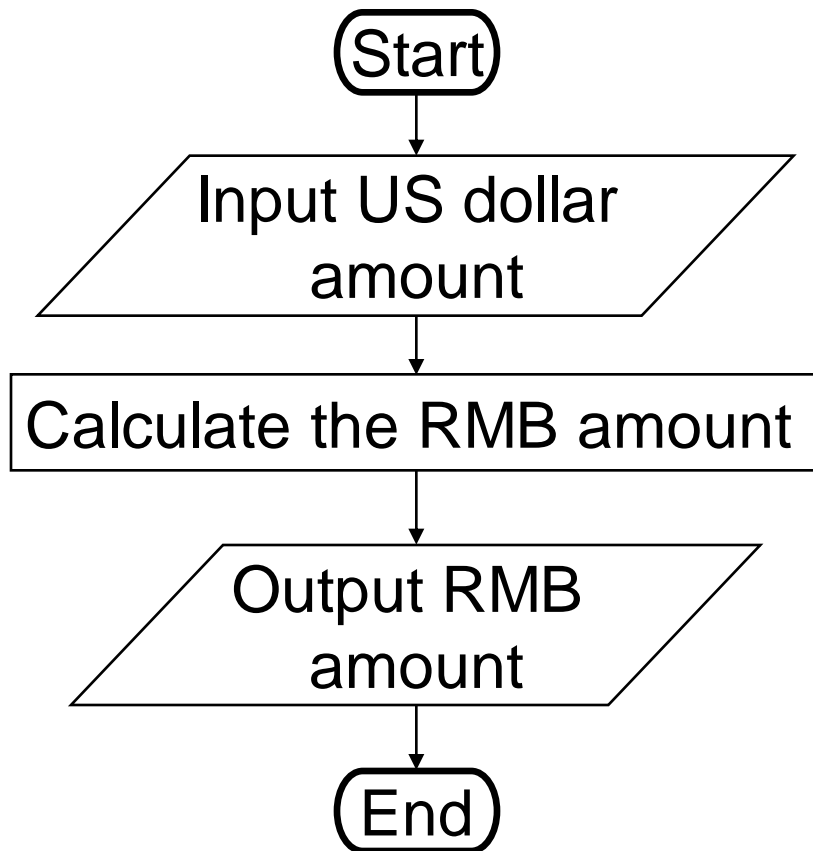
Code

```
// converts US$ to RMB Yuan
#include <stdio.h>

int main(){
  double us_Dollars;
  double rmb_Yuans;

// read in amount in US$
  printf("\nPlease enter USD amount and press return: ");
  scanf("%lf", &us_Dollars);

// calculate the RMB Yuan amount
  rmb_Yuans = 6.5 * us_Dollars;

// display the results
  printf(" %lf us_Dollars = %lf rmb_Yuans\n", us_Dollars,
         rmb_Yuans);
  return 0;
}
```
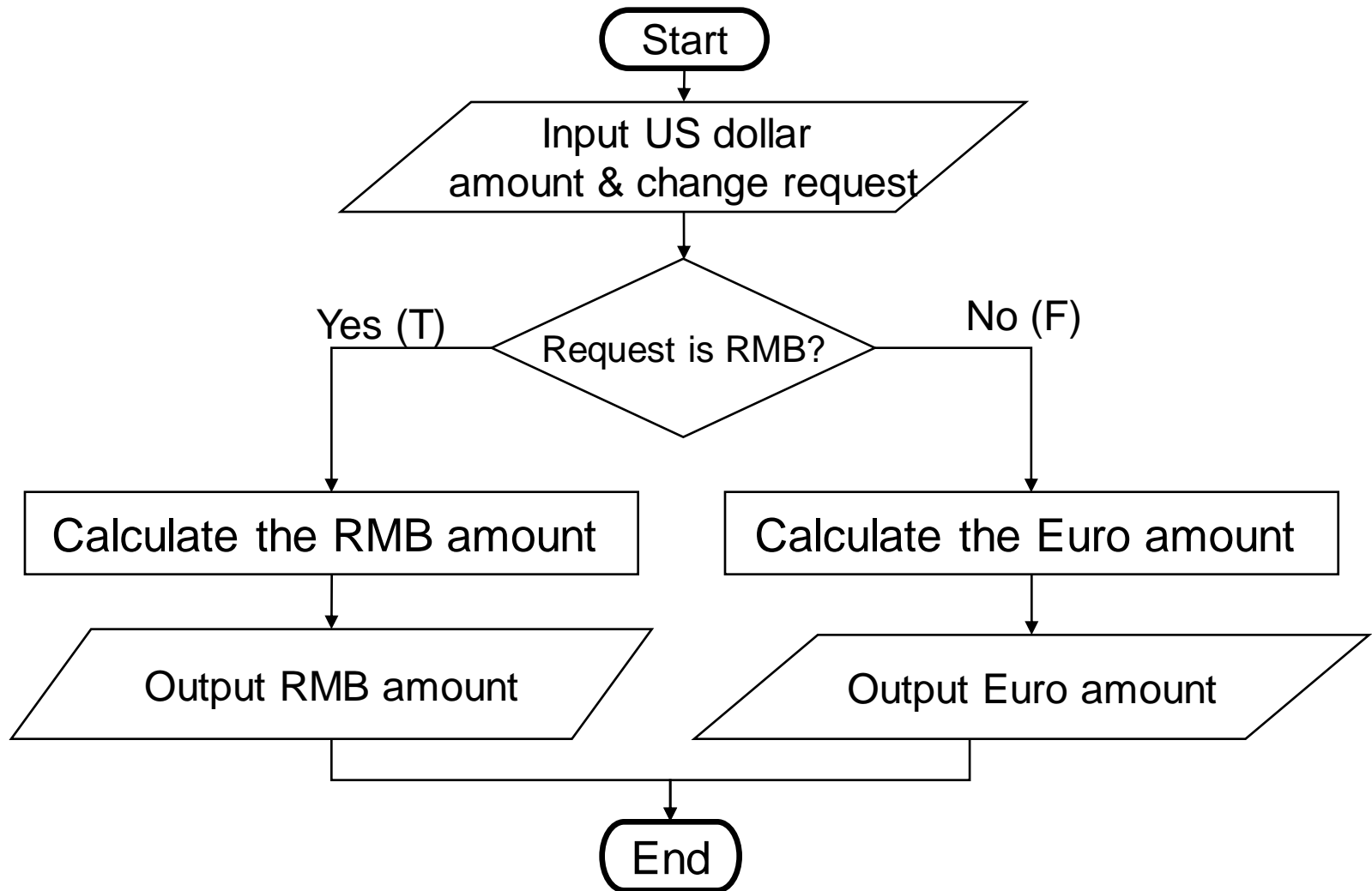
Structured Programming

Program Design

How can we express this in a flowchart:

Write a program to be able to convert US dollar to either RMB or Euro depending on the request of the user?

Program Design

Structured Programming

Program Design

How can we write a program to implement this flow chart?

Structured Programming