Data Structures and Algorithms

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Session: Motivation for Data Structures and Algorithms
Another Example Program

• Read a triangle and output its area

```c
#include <iostream>
using namespace std;
struct point {
    float x, y;
};
struct triangle{
    point p[3];
};
```
void read_point(point &p) {
    cin >> p.x >> p.y;
}

void read_triangle(triangle &t) {
    read_point(t.p[0]);
    read_point(t.p[1]);
    read_point(t.p[2]);
}
Area of a Triangle

```c
float area(triangle t) {
    return 0.5*abs((t.p[1].x-t.p[0].x)*(t.p[2].y-t.p[0].y)-(t.p[2].x-t.p[0].x)*(t.p[1].y-t.p[0].y));
}

int main() {
    triangle t;
    read_triangle(t);
    cout << area(t) << endl;
}
```
This program uses several data structures
No built-in data structure for triangles
C++ gives ways of defining our own data structures for different objects.
The built-in data structure float is used to represent the value of a coordinate
A point represented by its x and y coordinates
A triangle represented by an array of 3 points
Algorithm

• The program uses 4 functions
• A function to read a point and another to read a triangle
• A function that computes the area of a triangle
• The main function that reads a triangle and outputs its area
• No **built-in** functions available for these
• Need to define our own functions or algorithms for these
• Identify the data structures and algorithms needed to solve the given problem
  • Data structure: triangle
  • Algorithm: compute area of triangle
• Need other data structures for this
• A triangle is a set of 3 points
  • Data structure for point
• Need other algorithms
  • Input/Output of triangles and points
Building Data Structures and Algorithms

• Define our own types of variables to implement required data structures

• Define our own functions to implement the required algorithms

• Many different implementations may be possible for the same data structure or algorithm
Exercises

• Find an alternative data structure for triangles
• Find a different formula for computing the area of a triangle
• Write a program that takes two triangles as input and determines if they have a point in common