

Multiple Alternatives



AMOUNT OF TIME I'VE SPENT PARALYZED
BY INDECISION OVER CHOOSING THE RIGHT...



Due this week

- **Homework 2**

- Write solutions in VSCode and paste in Autograder, **Homework 2 CodeRunner**.
 - Zip your .cpp files and submit on canvas **Homework 2**.
- Start going through the textbook readings and watch the videos
 - Take **Quiz 3**.
- Participation: 3-2-1
- Check the due date! **No late submissions!!**

Practicum 1

- Coming up in week 5: Sep 19th during lecture
- Covers material from weeks 1 – 3 and H3
 - .cpp programs
 - Variables, arithmetic, cin, cout
 - If-else, nested if-else, switch statements
- Chapters 1, 2 and 3 from the textbook (everything!)
- Paper exam – bring writing utensils

Practicum – Format and Rules

Logistics:

- You may bring 1 sheet of handwritten notes
- Bring an ID to class
 - Student ID: BuffOne Card, Government ID
- You have **30 minutes** to complete it (tentative)
 - Focus on your own solution
 - This is an individual assessment!
 - There is not enough time to help others

Practicum - Practice, practice, practice!

- Review all previous assignments – quizzes, recitations and homeworks
- Review examples we did in class
- Practice Questions will be released on Monday, September 12th
- Time is short; prepare accordingly
 - Time yourself on practice problems

Tips for Timed Exam

- Read the Questions
 - read them not once, but **TWICE** before starting to code
- Create or Modify Code
 - know your C++ syntax
 - Know your data types, operators (arithmetic, relational, logical)
 - know how to create a condition
 - know how and when to use SWITCH and “break;”
- Spot and fix errors!

Today

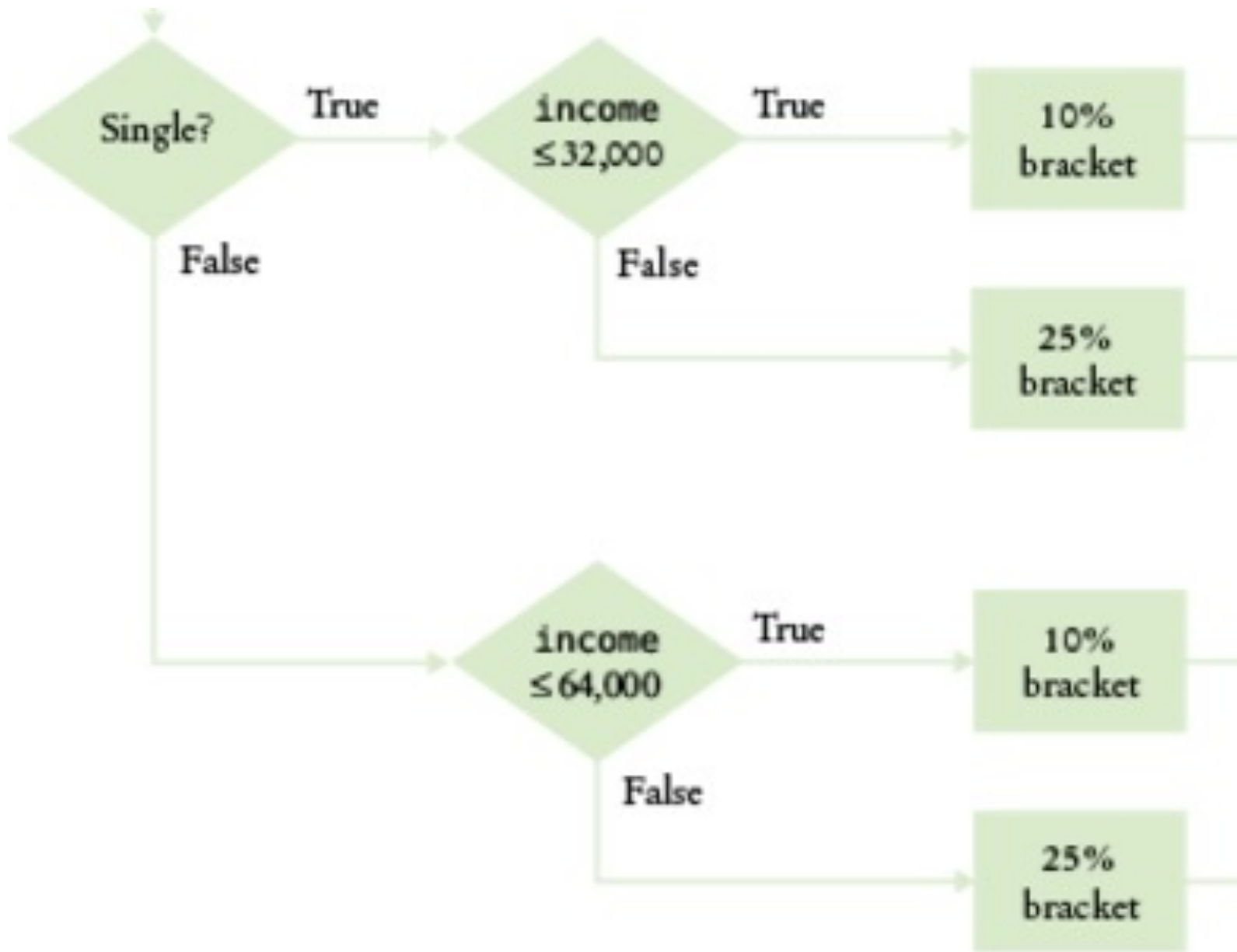
- Nested if, nested if else
- `switch` statement

Nested Branches

Nested Branches – Taxes

Table 4 Federal Tax Rate Schedule		
If your status is Single and if the taxable income is	the tax is	of the amount over
at most \$32,000	10%	\$0
over \$32,000	\$3,200 + 25%	\$32,000
If your status is Married and if the taxable income is	the tax is	of the amount over
at most \$64,000	10%	\$0
over \$64,000	\$6,400 + 25%	\$64,000

In the United States different tax rates are used depending on the taxpayer's marital status – single rates are higher. Married taxpayers add their income together and pay taxes on the total. See the IRS table below from a recent year:



Flowchart for Tax
Table Decisions

Nested Branches – Taxes – Complete Code part 1

```
#include <iostream>
#include <string>
using namespace std;
int main()
{
    const double RATE1 = 0.10;
    const double RATE2 = 0.25;
    const double RATE1_SINGLE_LIMIT = 32000;
    const double RATE1_MARRIED_LIMIT = 64000;

    double tax1 = 0;
    double tax2 = 0;

    double income;
    cout << "Please enter your income: ";
    cin >> income;

    cout << "Please enter s for single, m for married: ";
    string marital_status;
    cin >> marital_status;
```

Nested Branches – Taxes – Complete Code part 2

```
if (marital_status == "s")
{
    if (income <= RATE1_SINGLE_LIMIT)
    {
        tax1 = RATE1 * income;
    }
    else
    {
        tax1 = RATE1 * RATE1_SINGLE_LIMIT;
        tax2 = RATE2 * (income - RATE1_SINGLE_LIMIT);
    }
}
else
```

Nested Branches – Taxes – Complete Code part 2

```
{  
    if (income <= RATE1_MARRIED_LIMIT)  
    {  
        tax1 = RATE1 * income;  
    }  
    else  
    {  
        tax1 = RATE1 * RATE1_MARRIED_LIMIT;  
        tax2 = RATE2 * (income - RATE1_MARRIED_LIMIT);  
    }  
}  
  
double total_tax = tax1 + tax2;  
  
cout << "The tax is $" << total_tax << endl;  
return 0;  
}
```

Multiple Alternatives

Multiple Alternatives Need Multiple Nested `if ()` Statements

- In the case of the Richter Scale for earthquake magnitude, there are five branches:
 - one each for the four descriptions of damage, and a "default" fifth one for no destruction (not shown).

Table 3 Richter Scale	
Value	Effect
8	Most structures fall
7	Many buildings destroyed
6	Many buildings considerably damaged, some collapse
4.5	Damage to poorly constructed buildings

Flowchart for Richter Scale Code

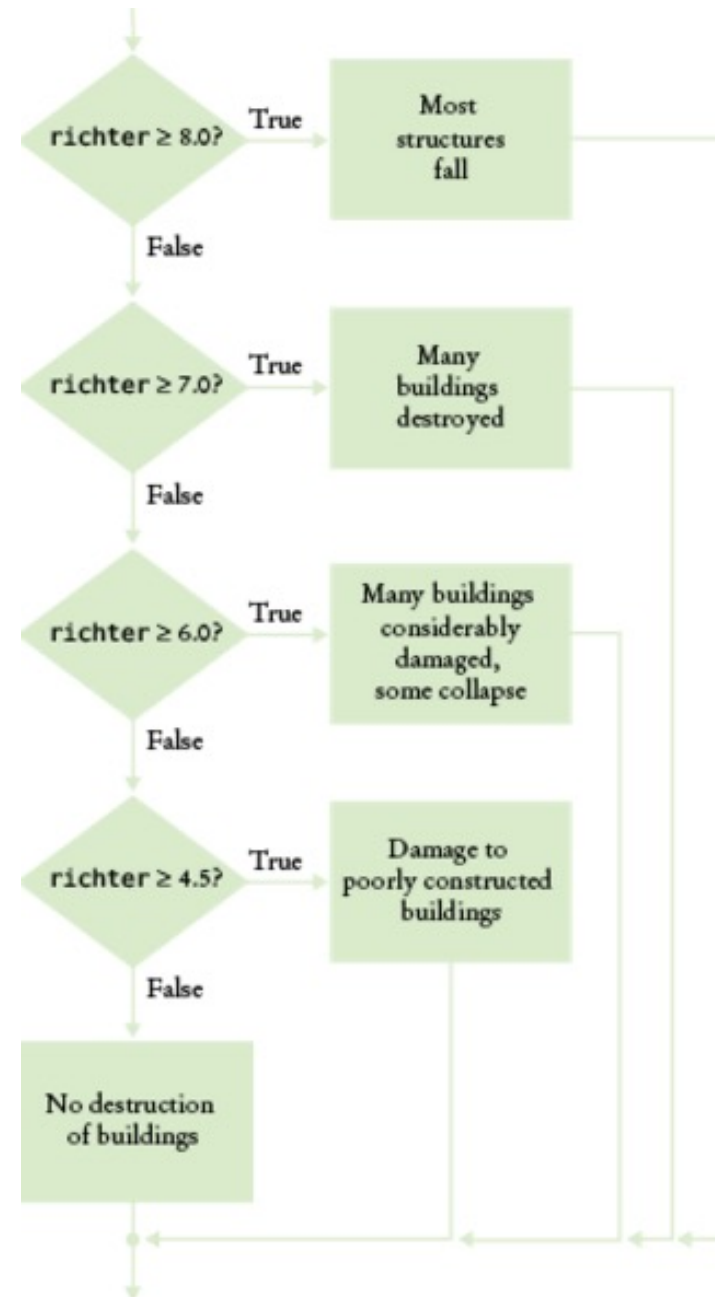


Figure 3 Multiple Alternatives

Multiple Alternatives (Richter Scale Code)

```
if (richter >= 8.0)
{
    cout << "Most structures fall";
}
else if (richter >= 7.0)
{
    cout << "Many buildings destroyed";
}
else if (richter >= 6.0)
{
    cout << "Many buildings considerably damaged, some collapse";
}
else if (richter >= 4.5)
{
    cout << "Damage to poorly constructed buildings";
}
else
{
    cout << "No destruction of buildings";
}
. . .
```

Multiple Alternatives – Order of Tests

- Because of this execution order, when using multiple if statements, pay attention to the order of the conditions.

Multiple Alternatives – Wrong Order of Tests

```
if (richter >= 4.5)    // Tests in wrong order
{
    cout << "Damage to poorly constructed buildings";
}
else if (richter >= 6.0)
{
    cout << "Many buildings considerably damaged, some collapse";
}
else if (richter >= 7.0)
{
    cout << "Many buildings destroyed";
}
else if (richter >= 8.0)
{
    cout << "Most structures fall";
}
```

Suppose the value of richter is 7.1. Because we tested small first with a \geq , the first statement is (wrongly) printed.

The switch Statement vs. the if statement

- Below is a complicated if() statement to choose a text string to assign based on the value of an int variable:

```
int digit;
... //digit variable gets set here by some code
if (digit == 1) { digit_name = "one"; }
else if (digit == 2) { digit_name = "two"; }
else if (digit == 3) { digit_name = "three"; }
else if (digit == 4) { digit_name = "four"; }
else if (digit == 5) { digit_name = "five"; }
else if (digit == 6) { digit_name = "six"; }
else if (digit == 7) { digit_name = "seven"; }
else if (digit == 8) { digit_name = "eight"; }
else if (digit == 9) { digit_name = "nine"; }
else { digit_name = ""; }
```

The switch Statement

- The switch statement is an alternative to nested `if() else` statements. But switch is at least as awkward to code as nested `if() else`:

```
int digit; //switch can only test int and char types
... //digit variable gets set here by some code
switch(digit)
{
    case 1: digit_name = "one"; break;
    case 2: digit_name = "two"; break;
    case 3: digit_name = "three"; break;
    case 4: digit_name = "four"; break;
    case 5: digit_name = "five"; break;
    case 6: digit_name = "six"; break;
    case 7: digit_name = "seven"; break;
    case 8: digit_name = "eight"; break;
    case 9: digit_name = "nine"; break;
    default: digit_name = ""; break; //taken if none of the above
}
```

break statements in the switch statement

- Every branch of the switch must be terminated by a break statement. And each branch must terminate with a semicolon.
- break tells the machine to skip down to the end of the switch statement, because a match was found.
- If the break is missing, execution falls through to the next branch, and so on, until finally a break or the end of the switch is reached.
- In practice, this fall-through behavior is rarely useful, and it is a common cause of errors.
- If you accidentally forget the break statement, your program compiles but executes unwanted code. Try it and see!